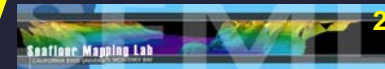


The importance of detailed ocean mapping for assessing the status of threatened marine organisms: a case study

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Abstract

Strong associations between marine organisms and the environments and habitats in which they live have proven to be important predictors of the distribution of various fishes and invertebrates. We surveyed the endangered white abalone, *Haliotis sorenseni*, using a remotely operated vehicle with the aid of detailed benthic maps produced by multibeam sonar surveys. Preliminary observations indicated that *H. sorenseni* reside mainly near the sand-rock interface at depths of 30 – 60 m, so surveys were concentrated at these areas. Abalone were surveyed using visual strip transect methods, and search area was precisely quantified for an estimate of density per unit area. Rocky habitat between the depths of 30 – 60 m was quantified using a combination of rugosity and Topographic Position Analysis (TPA). An estimate of the total number of white abalone residing at several offshore banks and islands was made possible by the quantification of habitat area. Habitat area was much larger than previously predicted, and therefore the predicted total number of white abalone was higher than previously reported. Although total numbers were higher than previous estimates, densities were more than an order of magnitude lower than historic values, and the distances between abalone (typically > 5 m) was larger than necessary for successful reproduction (< 2 m). The use of detailed habitat maps provided by multibeam sonar surveys was instrumental in choosing broad survey locations, specific transect locations, and in calculating the amount of available appropriate white abalone habitat.

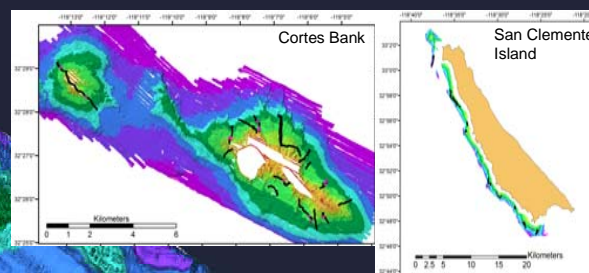


Figure 3. Multibeam maps of Cortes Bank and San Clemente Island. ROV tracklines are overlaid in black, and white abalone sightings are represented by pink dots.

Methods

Habitat was surveyed using multibeam sonar techniques during three cruises on the NOAA ship R/V *David Starr Jordan* at Tanner Bank, Cortes Bank, and San Clemente Island (Fig. 1, 3). The multibeam sonar system included a Reson 8101, and was used in conjunction with a Triton-Elis Isis System for data logging and sonar control. Delphmap and BathypPro software (Triton Elis International, Inc.) were used to create real-time side-scan mosaics and to generate digital elevation models. Multibeam data was processed with CARIS HIPS software, and all final GIS products were derived from shoal-biased data.

Results

The amount of rocky habitat between 30-60 m depth at all three sites was much greater than previously reported (poster background, Fig. 3, & Table 1). Results of multibeam sonar surveys revealed complex structures on the offshore banks. Erosion of more recent geologic units has exposed erosion-resistant marine sedimentary and volcanic rocks, that through differential erosion have developed layering and fracture features favorable to abalone.

A total of 258 individual white abalone were identified in all surveys, with the highest numbers seen at Tanner Bank in 2002 in the 40-50 m depth range (Fig. 5). The lowest densities were 0.0 abalone ha⁻¹ at SC in the 50-60 m depth range. No abalone were found shallower than 32 m or deeper than 61 m at any site. White abalone were stratified by depth overall, but search effort was focused on the middle depth range.

Site-specific white abalone population estimates were made based on the amount of available habitat quantified by the results of multibeam sonar surveys and white abalone density estimates from ROV surveys. See Table 2 for actual estimates.

Site	Total no. abalone ± se
Tanner Bank (2002)	12,819 ± 3,582
Tanner Bank (2004)	5,883 ± 3,582
Cortes Bank	7,366 ± 5,340
San Clemente Island	1,938 ± 1,598.

Table 2. White abalone population estimates

Discussion

The use of detailed habitat mapping techniques has proven to be an invaluable method to estimate amounts of different habitat types for the purposes of quantifying marine organisms within their specific habitat. Specifically, white abalone restoration efforts would be greatly enhanced by more surveys incorporating high resolution bathymetric maps that would serve to better define the characteristics of suitable white abalone habitat. Our concept of what a viable white abalone population is would benefit from more accurate density estimates for other areas within the historic range and a better understanding of how white abalone are distributed within populations.

The ultimate goals of recovery and eventual removal of white abalone from the Endangered Species List depends upon establishing confidence in the demographic parameters that define a viable white abalone population. It has become apparent that conducting studies such as this one, with continuing efforts to improve sample standardization techniques over time, is critical to achieving recovery goals.

References

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Acknowledgments

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Figure 1. Map of southern CA, including the 3 study areas.



Figure 2. The remotely operated vehicle (ROV) on the deck of the NOAA ship, R/V *David Starr Jordan*



Figure 4. *Haliotis sorenseni*

Remotely operated vehicle (ROV) surveys were conducted using strip transect methods at Tanner and Cortes Banks and San Clemente Island with a Phantom DS4 2+2 ROV (Fig. 2). Transects were located in areas of known white abalone habitat as determined by multibeam maps. Once an abalone was sighted the ROV was first positioned to take a high-resolution digital photograph of the animal for species confirmation (Fig. 4), and then positioned so that the lasers were visible on the animal for shell measurements. Area surveyed values allowed for estimates of white abalone density/unit area. Distances between abalone, sizes, and habitat associations were all determined from video and positional information.

Survey area	rocky area multibeam surveys	rocky area previous estimates
Tanner Bank	1,619 ha	62 ha
Cortes Bank	1,138 ha	100 ha
San Clemente Island	889 ha	40 ha
Remainder of CA	?	550 ha
Baja, Mexico	?	214 ha
Totals	> 3,252 ha	966 ha

Table 1. Area of rocky habitat measured by multibeam surveys and previous estimates

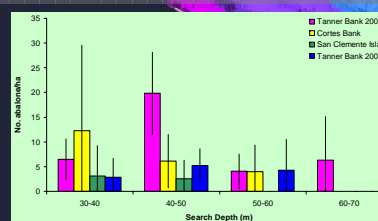


Figure 5. Density of abalone (± se) within 10 m depth bins at Tanner and Cortes Banks and San Clemente Island

Introduction

The importance of habitat for marine organisms has been displayed for fishes and invertebrates alike. The ability to pointedly survey sites of appropriate habitat for a particular species is crucial for planning efficient stock assessments. Mapping technology is now such that information beyond bathymetry is gathered relatively easily, and information at the habitat level is becoming a reality. The endangered white abalone, *Haliotis sorenseni*, is found exclusively in 30-70 m depths in rocky reef habitats, and more specifically, areas where the rock reef meets sand. Due to the endangered status of this species (NOAA, 200_) it is imperative that accurate estimates of densities are obtained to monitor the recovery or decline of populations. An endangered species poses a particularly urgent need for habitat and population surveys, but this issue is also of great importance for currently fished species, such as groundfish and fished benthic invertebrates, if we hope to prevent future large declines in populations.